UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/604,670	08/08/2003	John Zagaja	PES-0160	1669

23462 7590 04/10/2008
CANTOR COLBURN, LLP - PROTON
20 Church Street
22nd Floor
Hartford, CT 06103

EXAMINER	
WILKINS III, HARRY D	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
04/10/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/604,670	ZAGAJA ET AL.	
	Examiner	**Art Unit**	
	Harry D. Wilkins, III	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 December 2007 and 08 January 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20,22-27 and 30-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20,22-27 and 30-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 January 2008* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Status

1. The objection to the drawings has been obviated by Applicant's cancellation of the objected to figure 10.

2. The rejection of claim 30 under 35 U.S.C. 2nd paragraph has been withdrawn in view of Applicant's amendment to claim 30 correcting the antecedent basis problem.

3. Applicant's petition to add a late priority claim to prior applications 09/965,630, 60/235,743, 60/235,821 and 60/235,974 is noted. The petition was granted on 18 March 2008. As such, Shiepe et al (US 7,166,382 or WO 02/27846) does not constitute prior art against some of the presently pending claims since they find support in the prior application. It is noted that 09/965,630 is the corresponding U.S. application to patent no. 7,166,382.

4. The effective filing date of claims 1-8, 14-20, 22-25, 27, 31 and 32 is now considered to be 27 September 2001, the filing date of 09/965,630. The feature of a porous sintered support having a porosity gradient is not supported in any of the provisional applications to which Applicant is claiming priority. Therefore, Anderson et al (US 2003/0230495) no longer constitutes prior art against claim 20 and the rejection based on Anderson et al is hereby withdrawn.

5. The effective filing date of all other claims is considered to be 8 August 2003, the filing date of the present application. Therefore, Shiepe et al (US 7,166,382 or WO 02/27846) is eligible as prior art against claims 9-13, 26 and 28-30.

6. Applicant's amendments to both claims 1 and 20 requiring the first portion and the second portion to be adjacent to each other and on opposite sides of the support member from each other have overcome the rejection grounds based on Carlson et al. All rejection grounds previously set forth by the examiner utilizing Carlson et al as a primary reference are hereby withdrawn.

7. The examiner notes several references of record in the 09/965,630 application that have not been made of record in this application, including Mussell et al (WO 97/13287), Fuglevand et al (US 6,030,718) and Wilson (US 5,641,586), that are clearly material to the patentability of the present claims as defined in 37 CFR 1.56.

8. The listing of claims filed 8 January 2008 is substantially correct. However, it omits claims 28 and 29, and that their current status is cancelled. In the interest of reducing prosecution time, the examiner merely notes the error here as opposed to sending out a notice of informal amendment.

Claim Rejections - 35 USC § 112

9. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

10. Claim 30 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification as filed fails to support the

feature that the channels (e.g.-102 from figure 4) are formed between the first portion of the support member and the second portion of the support member. The relevant disclosure appears on pages 22-23 of the specification as filed. The “first major surface 98” of the “first portion 92” contained the channels, and the “first major surface 98” is described (in the context of figure 3) as the “upper surface”, and thus, the side of portion 92 facing opposite the membrane. Further, it should be noted that the naming convention in the claims and the specification are different, in that the portion opposite the membrane electrode assembly (76) is referred to as the “second portion” or “third portion” in the claims, but as the “first portion 92” in the specification. Further, the drawings show only channels formed in either the first or second portions. Applicant’s statement in paragraph [0047] that “channel(s) (e.g., in second portion 94 and/or in first portion 92)” would be interpreted by one of ordinary skill in the art to mean that channels were formed either in the second portion or in the first portion, or that there were separate channels in both the first and second portions. Channels in both the first and second portions does not mean that the channels are “between” the first and second portions as is presently claimed by claim 30.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent

> granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

12. Claims 1, 7, 8, 9, 15-19 and 31 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381).

Rosenmayer anticipates the invention as claimed. Rosenmayer teaches (see abstract, figure 1 and col. 3, line 40 to col. 5, line 16 and Examples 3 and 4) an electrochemical cell including first (5) and second (not pictured) electrodes on opposite sides of a membrane (6), and a sintered porous support (3,4) having a first porosity on the first side facing the membrane and a second, different porosity on the second side facing opposite from the membrane. Rosenmayer teaches (see col. 3, lines 48-57) that the structure (3, 4) is adapted with respect to each layers pore volume in order to achieve a gradient in terms of gas permeability. Thus, the structure has a porosity gradient to achieve a gradient of gas permeability.

Regarding claim 7, Rosenmayer teaches (see col. 3, lines 48-53) that the porosity gradient occurred either in a step-wise layer fashion or continually. Thus, Rosenmayer teaches making the porous support member with three of more portions having varying porosities.

Regarding claim 8, the support member of Rosenmayer was made of two layers (3, 4) wherein the layer (4) had a porosity greater than the previous layer (3).

Regarding claim 9, Rosenmayer teaches (see col. 3, lines 48-53) that the porosity gradient occurred either in a step-wise layer fashion or continually.

Regarding claims 15-18, Rosenmayer teaches (see col. 5, lines 8-12) that the sintered porous supports (with porosity gradient) were known to be utilized on both sides of the electrochemical cell, such that the second support member was arranged adjacent to the second electrode.

Regarding claim 19, Rosenmayer teaches (see figure 1 and col. 3, lines 48-57) that the sintered porous support was electrically conductive. Therefore, the sintered porous support (in intimate contact with electrode 5) would have also acted as an extension to the first electrode.

Regarding claim 31, Rosenmayer teaches making the porous support member from two distinct layers.

13. Claims 1-6, 8, 15, 17-18 and 31 are rejected under 35 U.S.C. 102(e) as being anticipated by Gorman et al (US 2002/0086195).

Gorman teaches an electrochemical cell comprising first and second electrode separated by an ionic membrane (Fig. 2, numerals 42a, 38a and 40a), and a bilayer electrode support member on both side of the electrodes(fig. 2 numerals 44a and 46a), the bilayer electrode support member comprising a fine pore layer with 50% porosity and a coarse pore layer with 65-75% porosity(page 2 paragraph 13).

Regarding claims 1-2, the finer layer of the bilayer support member as taught by Gorman reads on the claimed first portion of the porous support member. The coarse layer of the bilayer support member as taught by Gorman reads on the claimed second portion of the porous support member.

Even though Gorman does not teach that the bilayer porous support member is sintered, the electrochemical cell of Gorman meets all the structural limitations of the instant claim. The examiner interprets the term “sintered” as describing how the support member is made, i.e. - a process limitation. Therefore, the claimed limitation of “sintered” support member does not lend patentability to the instant apparatus claim.

Regarding claims 3-4, the finer layer of the bilayer support member as taught by Gorman (50% porosity) reads on the claimed first portion porosities of less than or equal to about 60% as recited in claim 3 and the claimed porosity of about 35% to about 50% as recited in claim 4.

Regarding claims 5-6, the coarse layer of the bilayer support member as taught by Gorman (65-75% porosity reads on the claimed second portion porosity of greater than or equal to about 50% as recited in claim 5 and the claimed porosity of about 50% to about 70% as recited in claim 6.

Regarding claim 8, the bilayer support member includes a plurality of layers wherein each layer has a layer porosity of greater than or equal to a previous layer.

Regarding claim 15-18, Gorman teaches the claimed additional porous support member with the second portion (i.e. coarse layer) having greater porosity than the first portion(i.e. fine layer) on the other side of the membrane as claimed.

Regarding claims 16 and 19, the porous bilayer of Gorman was made from electrically conductive material and was in intimate contact with the electrode. Therefore, the porous support would have also acted as an extension to the electrodes.

Regarding claim 31, the bilayer porous support member as taught by Gorman in view of Shiepe comprises the claimed first and second layers.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiepe et al (US 7,166,382 and WO 02/27846) in view of Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381).

Shiepe et al teach (see abstract, figures 3-4 and col. 6, line 45 to col. 11, line 35) an electrochemical cell include first and second electrodes separated by a membrane and a sintered metal porous support layer (col. 6, lines 60-64), wherein the porosity of the support changes from a first face facing the membrane to the second face opposite the membrane (col. 10, lines 25-42).

However, Shiepe et al do not explicitly teach the claimed single layer porous support member with porosity gradient.

Rosenmayer teaches (see col. 3, lines 48-57) that changing porosities in a layer can be accomplished either with discrete layers (as in the case of Shiepe et al) or by a continuous gradient in one layer.

Therefore, it would have been obvious to one of ordinary skill in the art to have substituted a porous support which had a continuous porosity gradient instead of

distinct layers having different porosities as suggested by Rosenmayer since Rosenmayer teaches that the two options are functional equivalents.

16. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gorman et al (US 2002/0086195) in view of Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381).

The teachings of Gorman et al are discussed above.

However, Gorman et al do not explicitly teach the claimed singer layer porous support member with porosity gradient.

Rosenmayer teaches (see col. 3, lines 48-57) that changing porosities in a layer can be accomplished either with discrete layers (as in the case of Gorman et al) or by a continuous gradient in one layer.

Therefore, it would have been obvious to one of ordinary skill in the art to have substituted a porous support which had a continuous porosity gradient instead of distinct layers having different porosities as suggested by Rosenmayer since Rosenmayer teaches that the two options are functional equivalents.

17. Claims 10-12 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shiepe et al (US 7,166,382 and WO 02/27846) in view of Wilkinson et al (US 5,252,410).

The teachings of Shiepe et al are described above.

However, Shiepe et al do not teach forming flow field channels in the support member.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Shiepe et al to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

Regarding claims 11-12, Wilkinson et al teach (see e.g.-figures 11 and 12 and figures 13 and 14) providing flow channels all of which extend from an inlet proximate to an edge of the side, and which end at a terminus either near the center of the side (figures 11 and 12) or at a different edge of the side (figures 13 and 14).

Regarding claim 30, in order to have the reactants as close to the membrane as possible to increase efficiency, it would have been obvious to one of ordinary skill in the art to have placed the channels in the porous layer adjacent to the membrane, rather than in a porous layer furthest from the membrane.

18. Claims 10-12 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381) in view of Wilkinson et al (US 5,252,410).

The teachings of Rosenmayer are described above. Rosenmayer teaches forming flow channels in the current collector plate (1).

Thus, Rosenmayer does not teach forming flow field channels in the support member.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Rosenmayer to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

Regarding claims 11-12, Wilkinson et al teach (see e.g.-figures 11 and 12 and figures 13 and 14) providing flow channels all of which extend from an inlet proximate to an edge of the side, and which end at a terminus either near the center of the side (figures 11 and 12) or at a different edge of the side (figures 13 and 14).

Regarding claim 30, in order to have the reactants as close to the membrane as possible to increase efficiency, it would have been obvious to one of ordinary skill in the

art to have placed the channels in the porous layer adjacent to the membrane, rather than in a porous layer furthest from the membrane.

19. Claims 10-12 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gorman et al (US 2002/0086195) in view of Wilkinson et al (US 5,252,410).

The teachings of Gorman et al are described above. Gorman et al teach forming flow channels in the current collector plate.

Thus, Gorman et al do not teach forming flow field channels in the support member.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Gorman et al to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

Regarding claims 11-12, Wilkinson et al teach (see e.g.-figures 11 and 12 and figures 13 and 14) providing flow channels all of which extend from an inlet proximate to

an edge of the side, and which end at a terminus either near the center of the side (figures 11 and 12) or at a different edge of the side (figures 13 and 14).

Regarding claim 30, in order to have the reactants as close to the membrane as possible to increase efficiency, it would have been obvious to one of ordinary skill in the art to have placed the channels in the porous layer adjacent to the membrane, rather than in a porous layer furthest from the membrane.

20. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiepe et al (US 7,166,382 and WO 02/27846) in view of Carlson et al (US 5,372,689).

The teachings of Shiepe et al are described above.

However, Shiepe et al do not teach forming regions on the porous support member having differing porosities.

Carlson et al teach (see col. 3, lines 45-67) that formation of regions, one having large pores and one having small pores, in a porous support member in an electrochemical cell results in increasing the dual-directional flow of reactants and products to and from the membrane, thereby providing adequate support without compromising the efficiency of the electrochemical cell.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated regions having large pores and regions having small pores into the porous support member of Shiepe et al for the purpose of enhancing dual-directional flow of reactants and products to and from the membrane to thereby allow the porous support member to provide adequate support without compromising the efficiency of the electrochemical cell.

21. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381) in view of Carlson et al (US 5,372,689).

The teachings of Rosenmayer are described above.

However, Rosenmayer does not teach forming regions on the porous support member having differing porosities.

Carlson et al teach (see col. 3, lines 45-67) that formation of regions, one having large pores and one having small pores, in a porous support member in an electrochemical cell results in increasing the dual-directional flow of reactants and products to and from the membrane, thereby providing adequate support without compromising the efficiency of the electrochemical cell.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated regions having large pores and regions having small pores into the porous support member of Rosenmayer for the purpose of enhancing dual-directional flow of reactants and products to and from the membrane to thereby allow the porous support member to provide adequate support without compromising the efficiency of the electrochemical cell.

22. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gorman et al (US 2002/0086195) in view of Carlson et al (US 5,372,689).

The teachings of Gorman et al are described above.

However, Gorman et al do not teach forming regions on the porous support member having differing porosities.

Carlson et al teach (see col. 3, lines 45-67) that formation of regions, one having large pores and one having small pores, in a porous support member in an electrochemical cell results in increasing the dual-directional flow of reactants and products to and from the membrane, thereby providing adequate support without compromising the efficiency of the electrochemical cell.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated regions having large pores and regions having small pores into the porous support member of Gorman et al for the purpose of enhancing dual-directional flow of reactants and products to and from the membrane to thereby allow the porous support member to provide adequate support without compromising the efficiency of the electrochemical cell.

23. Claims 14, 20, 22-25, 27 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381) in view of Fuglevand (US 6,030,718).

The teachings of Rosenmayer are discussed above.

However, Rosenmayer does not explicitly teach the claimed pressure pad.

Fuglevand et al teach (see figures 12-13) including a pressure pad (e.g.-204) within an electrochemical cell for the purpose of (see paragraph spanning cols. 21 and 22) to improve force distribution to the electrodes, which one of ordinary skill in the art would know would thereby improve electrical efficiency by ensuring adequate electrical contact between the electrode and current collector.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated a pressure pad as suggested by Fuglevand et al within the electrochemical cell of Rosenmayer to improve the cell operating conditions.

Regarding claims 24-25, since Rosenmayer in view of Fuglevand et al teach an electrochemical cell that is structurally substantially the same as that of the instant invention, one of ordinary skill in the art would have found it obvious that the porous member of Rosenmayer in view of Fuglevand et al is inherently capable of supporting the membrane at pressure of greater than or equal to about 100 or 500 psi as claimed.

Regarding claim 32, the multi-layer porous support member as taught by Rosenmayer comprises the claimed first and second layers.

24. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosenmayer et al (DE 19840517, with reference to its English equivalent US 6,605,381) in view of Fuglevand et al (US 6,030,718), as applied above to claim 20 and further in view of Wilkinson et al (US 5,252,410).

The teachings of Rosenmayer et al in view of Fuglevand et al are discussed above.

However, Rosenmayer et al in view of Fuglevand et al do not explicitly teach the claimed channel.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col.

4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Rosenmayer et al to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

25. Claims 14, 20, 22-25, 27, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gorman et al (US 2002/0086195) in view of Fuglevand (US 6,030,718).

The teachings of Gorman et al are discussed above.

However, Gorman et al do not explicitly teach the claimed pressure pad.

Fuglevand et al teach (see figures 12-13) including a pressure pad (e.g.-204) within an electrochemical cell for the purpose of (see paragraph spanning cols. 21 and 22) to improve force distribution to the electrodes, which one of ordinary skill in the art would know would thereby improve electrical efficiency by ensuring adequate electrical contact between the electrode and current collector.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated a pressure pad as suggested by Fuglevand et al within the electrochemical cell of Rosenmayer to improve the cell operating conditions.

Regarding claims 24-25, since Gorman in view of Fuglevand et al teach an electrochemical cell that is structurally substantially the same as that of the instant

invention, one of ordinary skill in the art would have found it obvious that the porous member of Gorman in view of Fuglevand et al is inherently capable of supporting the membrane at pressure of greater than or equal to about 100 or 500 psi as claimed.

Regarding claim 32, the bilayer porous support member as taught by Gorman in view of Fuglevand et al comprises the claimed first and second layers.

26. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gorman et al (US 2002/0086195) in view of Fuglevand et al (US 6,030,718) as applied above to claim 20 and further in view of Wilkinson et al (US 5,252,410).

The teachings of Gorman in view of Fuglevand et al are discussed above.

However, Gorman in view of Fuglevand et al do not explicitly teach the claimed channel.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Gorman et al to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

27. Claims 1-6, 8, 15-19 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586).

Mussell et al teach (see abstract, figures and in particular pages 3-4 and 11) an electrochemical cell including a membrane electrode assembly (first and second electrodes and sandwiched membrane therebetween) and a porous support member disposed on and in fluid communication with, each electrode opposite the membrane, wherein the porous support member has a different porosity at the same position at one face (facing towards the electrode) as opposed to the other face (facing away from the electrode). Mussell et al do teach (see page 12) that the porous support member could be made from titanium-based compositions, but also it could be made from carbon felt (see page 14).

Thus, Mussell et al fail to expressly teach a sintered material for the porous support member.

Wilson teaches an electrochemical cell comprising first and second electrodes, an electrolyte membrane, first and second flow fields (12), and a porous flow field member (24) in fluid communication with the first flow field (see Fig. 1B). The member comprises a porous support modified to provide hydrophilicity or hydrophobicity (see col. 4, line 46 et seq). The porous support may comprise sintered particles, woven metal screens (cloths), and non-woven metal screens (see col. 5, line 10).

Therefore, the artisan would be motivated to use the structures of Wilson ‘586 in the electrochemical cell of Mussell et al because the disclosure of Wilson indicates that sintered metal particles are functionally equivalent to carbon cloths when used in porous

current-collecting members for electrochemical cells. As such, it would be obvious to substitute the sintered metal of Wilson 586 for the carbon paper of Fuglevand. An express suggestion to substitute one equivalent component or process for another is not necessary to render such substitution obvious. *In re Fout*, 675 F.2d 297, 213 USPQ 532 (CCPA 1982); MPEP §2144.06.

Regarding claims 2-6, Mussell et al teach (see page 14) that the small pore region (first portion) has a porosity of at least 10% and that the large pore region (second portion) has a porosity of at least 82%. Selection of optimum porosities is considered within the skill of a routineer in the art with limited routine experimentation.

Regarding claims 8 and 31, the porous support of Mussell et al was formed as two discrete layers having different porosities.

Regarding claims 15-18, Mussell et al suggests placing the porous support member on both sides of the membrane electrode assembly.

Regarding claims 16 and 19, since the porous support of Mussell et al was conductive, and in contact with either the first or second electrode of the membrane electrode assembly, the porous support also acted as an electrode at the same potential as either the first or second electrode.

28. Claims 7 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586) as applied above to claim 1, and further in view of Carlson et al (US 5,372,689).

The teachings of Mussell et al and Wilson are described above.

However, Mussell et al do not teach forming regions on the porous support member having differing porosities.

Carlson et al teach (see col. 3, lines 45-67) that formation of regions, one having large pores and one having small pores, in a porous support member in an electrochemical cell results in increasing the dual-directional flow of reactants and products to and from the membrane, thereby providing adequate support without compromising the efficiency of the electrochemical cell.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated regions having large pores and regions having small pores into the porous support member of Mussell et al for the purpose of enhancing dual-directional flow of reactants and products to and from the membrane to thereby allow the porous support member to provide adequate support without compromising the efficiency of the electrochemical cell.

29. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586) as applied above to claim 1, and further in view of Rosenmayer (DE 19840517, with reference to its English equivalent US 6,605,381).

The teachings of Mussell et al and Wilson are described above.

However, Mussell et al do not teach the claimed single layer porous support member with porosity gradient.

Rosenmayer teaches (see col. 3, lines 48-57) that changing porosities in a layer can be accomplished either with discrete layers (as in the case of Mussell et al) or by a continuous gradient in one layer.

Therefore, it would have been obvious to one of ordinary skill in the art to have substituted a porous support which had a continuous porosity gradient instead of distinct layers having different porosities as suggested by Rosenmayer since Rosenmayer teaches that the two options are functional equivalents.

30. Claims 10-12 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586) as applied above to claim 1, and further in view of Wilkinson et al (US 5,252,410).

The teachings of Mussel et al and Wilson are described above.

However, Mussell et al do not teach forming flow field channels in the support member.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced "repeating unit" thickness (increasing the power-to-volume ratio of the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Mussell et al to provide adequate

circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

Regarding claims 11-12, Wilkinson et al teach (see e.g.-figures 11 and 12 and figures 13 and 14) providing flow channels all of which extend from an inlet proximate to an edge of the side, and which end at a terminus either near the center of the side (figures 11 and 12) or at a different edge of the side (figures 13 and 14).

Regarding claim 30, in order to have the reactants as close to the membrane as possible to increase efficiency, it would have been obvious to one of ordinary skill in the art to have placed the channels in the porous layer adjacent to the membrane, rather than in a porous layer furthest from the membrane.

31. Claims 14, 20 22-25, 27 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586) as applied above to claim 1, and further in view of Fuglevand (US 6,030,718).

The teachings of Mussell et al are discussed above.

However, Mussell et al do not explicitly teach the claimed pressure pad.

Fuglevand et al teach (see figures 12-13) including a pressure pad (e.g.-204) within an electrochemical cell for the purpose of (see paragraph spanning cols. 21 and 22) to improve force distribution to the electrodes, which one of ordinary skill in the art would know would thereby improve electrical efficiency by ensuring adequate electrical contact between the electrode and current collector.

Therefore, it would have been obvious to one of ordinary skill in the art to have incorporated a pressure pad as suggested by Fuglevand et al within the electrochemical cell of Mussell et al to improve the cell operating conditions.

Regarding claims 24-25, since Mussell et al in view of Fuglevand et al teach an electrochemical cell that is structurally substantially the same as that of the instant invention, one of ordinary skill in the art would have found it obvious that the porous member of Mussell et al in view of Fuglevand et al is inherently capable of supporting the membrane at pressure of greater than or equal to about 100 or 500 psi as claimed.

Regarding claim 32, the multi-layer porous support member as taught by Mussell et al comprises the claimed first and second layers.

32. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mussell et al (WO 97/13287) in view of Wilson (US 5,641,586) as applied above to claim 1, and further in view of Fuglevand et al (US 6,030,718) as applied above to claim 20, and further in view of Wilkinson et al (US 5,252,410).

The teachings of Mussell et al in view of Fuglevand et al are discussed above.

However, Mussell et al in view of Fuglevand et al do not explicitly teach the claimed channel.

Wilkinson et al teach (see abstract, figures 2-3 and col. 8, line 28 to col. 9, line 40) including channels in a porous electrode/membrane support member for the purpose of distributing reactants to the electrodes. The channels formed in the porous electrode/membrane support member had the advantages of (see col. 3, line 42 to col. 4, line 16) reduced “repeating unit” thickness (increasing the power-to-volume ratio of

the fuel cell) and decreasing the distance between the reactants and the electrodes, thereby increasing efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have formed channels in the porous support member of Mussell et al to provide adequate circulation of reactants within the fuel cell while achieving a higher power-to-volume ratio and efficiency.

Response to Arguments

33. Applicant's arguments filed 8 March 2007 have been fully considered but they are not persuasive. Applicant has argued that:

a. Rosenmayer teaches a gas permeability gradient not a porosity gradient.

In response, Rosenmayer teaches (see col. 3, lines 48-57) that the structure (3, 4) is adapted with respect to each layers pore volume in order to achieve a gradient in terms of gas permeability. Thus, the structure has a porosity gradient to achieve a gradient of gas permeability.

b. Gorman et al fails to teach a sintered support.

In response, as previously indicated Applicant has provided no showing of what structural differences exist between using a sintered porous support and a non-sintered porous support. Absent a showing of a concrete difference in structure, the examiner stands behind the prior rejection grounds.

c. The combination of Rosenmayer with Wilkinson fails to meet the claimed invention because the channels of Wilkinson were formed in a non-porous layer.

In response, this is not found persuasive because the section of Wilkinson referenced by Applicant (col. 8, lines 40-45) is directed to figure 2 which is clearly labeled as Prior Art. Thus, Applicant's argument is without merit because the cited section of Wilkinson was directed to a description of the state of the art at the time of Wilkinson's invention, and not to the invention of Wilkinson.

Inventorship

34. In view of the papers filed 9 April 2004, it has been found that this nonprovisional application, as filed, through error and without deceptive intent, improperly set forth the inventorship, and accordingly, this application has been corrected in compliance with 37 CFR 1.48(a). The inventorship of this application has been changed by adding Thomas Skoczylas as the last named inventor.

The application will be forwarded to the Office of Initial Patent Examination (OIPE) for issuance of a corrected filing receipt, and correction of Office records to reflect the inventorship as corrected.

Conclusion

35. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Harry D. Wilkins, III whose telephone number is 571-272-1251. The examiner can normally be reached on M-F 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Susy Tsang-Foster can be reached on 571-272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Harry D Wilkins, III/

Primary Examiner, Art Unit 1795

hdw